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MEMO FOR: Distribution

FROM: Richard Borneman
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SUBJECT: 2002 Summary of the Precipitation Program in SAB

BACKGROUND AND CURRENT STATUS OF PROGRAM

The Satellite Analysis Branch (SAB) of the National Environmental Satellite, Data, and Information Service (NESDIS) provides quantitative satellite precipitation estimates (SPE's) and satellite guidance to the National Weather Service (NWS) whenever heavy convective rains threaten to produce, or are producing flash flooding. This is done for the lower 48 states and occasionally for Puerto Rico. Estimates are also provided for significant heavy rains and heavy snow with winter storms, and for heavy lake effect snows. The estimates are sent as part of the satellite-derived precipitation message (SPENES) on the Advanced Weather Interactive Processing System (AWIPS). SPENES is the AWIPS ID, and the WMO header for this message is TXUS20 KWBC. The SPENES message also contains guidance on satellite analysis, trends, and short range forecasts. Satellite estimates and guidance messages use GOES infrared (IR) and visible imagery; and messages also contain information from GOES water vapor imagery, GOES derived products and Sounder data, Defense Meteorological Satellite Program (DMSP) Special Sensor Microwave Imager (SSM/I) microwave data, and NOAA-15, 16 & 17 Advanced Microwave Sounder Unit (AMSU) data, as well as blends of various satellite data. The first 2 attachments are samples of SPENES messages sent during 2002. One is for the extremely heavy rains which caused extensive flooding over Texas in the beginning of July, and the other is for the El Nino storms that pounded the West Coast in December.

Satellite precipitation estimates are produced by the Automatic Rainfall Estimator (Auto-Estimator or AE), the latest version of the AE which is the Hydro-Estimator (H-E), and the IFFA (Interactive Flash Flood Analyzer). The Auto-Estimator has been the primary source of operational rainfall estimates beginning in June 2000. The AE was replaced by the H-E as the operational system in September 2002. These automatic rainfall estimators are used about 75% of the time for satellite rainfall estimates, and the IFFA is used for the remaining times for which estimates are produced. The Auto-Estimator was originally developed by Dr. Gilberto Vicente, Office of Research and Applications (ORA)/NESDIS, to automatically produce rainfall estimates every half hour for the entire continental U.S. (CONUS) using the GOES IR imagery. It uses an algorithm based on IR cloud top temperatures and changes in temperatures to determine an

instantaneous rainfall rate. Instantaneous rates derived every 15 minutes are combined to produce continuous products of hourly and 3 hour estimated totals for the whole U.S. every 30 minutes, 6 hour totals every hour, and 24 hour totals at 12Z. Corrections are also applied to the estimates for parallax (satellite viewing angle), available moisture, and orographics. In addition, radar reflectivity screening is used as a rain/no-rain discriminator, and an automatic equilibrium level (EL) adjustment from the Eta model is applied to warm top convection - warmer than -60C. Using the Auto-Estimator and Hydro-Estimator for operations allows the SAB Meteorologists to produce more SPENES messages for heavy rains and flash flood guidance, and to cover more heavy rain events. The timeliness of SAB rainfall estimates and SPENES messages also improves using the Auto-Estimator when compared with the IFFA operations.

The Hydro-Estimator was developed by Clay Davenport, a contractor working for the ORA Hydrology Team under the direction of Dr. Rod Scofield. The Hydro-Estimator algorithm differs from the AE by using a brightness temperature screening technique. It adjusts the rain rate assigned to each picture element (pixel) according to the surrounding pixel temperatures. This helps separate raining and non-raining pixels and decreases the need for radar screening. It also helps focus rainfall estimate totals into more clearly defined maximums. There is less of a tendency for overestimating for very cold cloud tops using the H-E, and it does a much better job of estimating for large mesoscale convective complexes (MCC's). The H-E also has a different way of handling the moisture corrections, and also produces more frequent products every 15 minutes for all except the 24 hour totals. The 1 hour H-E totals are now available on the NWS AWIPS system as a graphic for the whole CONUS every hour.

The Auto-Estimator and Hydro-Estimator work well for most cold top convection during the summer season for SAB precipitation operations. However, they do not work well for most winter storm, snowfall estimates, and for some warm top convection. As a result, it is up to the judgment of the SAB Meterorologist, based on his experience, to decide which system (AE, H-E or IFFA) is best to use for SAB Precipitation Operations.

The quantitative estimating techniques developed by Dr. Rod Scofield of ORA, and modified by SAB meteorologists, are used on the IFFA for convective rains and winter storms for which the Auto-Estimator is not used. A NESDIS in-house technique developed by SAB is used for lake effect snows. The techniques use cloud top temperatures and satellite signatures on the imagery to determine hourly and half hourly estimates from a series of animated IR and visible images. The IFFA is a man-machine interactive system where estimates are done manually and then stored and totaled for whatever time period is needed. An orographic correction can be applied to the IFFA estimates for time periods of 9 hours or less in the mountainous areas of the western U.S. and the Appalachians.

The IFFA and AE rainfall estimates are put onto the Internet as a graphical product on the SSD homepage. The WWW address for the homepage is: **http://www.ssd.noaa.gov** , and the estimate graphics can be found under the operational products and services. The SPENES messages are also there. The graphics are available in real-time and are estimates for short time periods such as 1, 3, and 6 hour totals and are usually paired up with a particular SPENES message.

The NPPU

The SAB precipitation operations are collocated with the Hydrological Prediction Center (HPC) of the National Center for Environmental Prediction (NCEP) in what is called the National Precipitation Prediction Unit (NPPU) in the NOAA Science Center. The SAB precipitation meteorologists give HPC forecasters 6 regularly scheduled satellite briefings per day as input for their Quantitative Precipitation Forecasts (QPF's) with special emphasis on heavy precipitation and short range trends. Big changes have occurred in the suite of HPC QPF products over the past 2-3 years. SAB has made adjustments to the time and contents of the scheduled briefings in order to provide maximum satellite input corresponding to the HPC products schedule. All of the satellite products that are available for input into the SPENES messages are also used in briefing HPC as input for the HPC QPF's, excessive rainfall potential outlooks, and heavy snow forecasts. Additional unscheduled briefings are given to HPC by the SAB precipitation meteorologists any time there is new satellite data available that would be of value in analyzing or forecasting heavy precipitation. SAB and HPC have had this close working relationship since 1993 in the NPPU, and the satellite input has been very important for the HPC operations.

2002 HIGHLIGHTS

Operational Improvements

In September 2002, the Hydro-Estimator became the official operational version of the Auto-Estimator. This was done in preparation for its transmission onto the AWIPS, and also means that there is now full time maintenance support. A version of the H-E with radar screening is being produced for SAB, along with a version without radar for the NWS. The H-E 1 hour totals that are transmitted on AWIPS contain no radar screening. In addition, the original Auto-Estimator version is still being produced and is available to SAB for precipitation operations.

The SAB precipitation Meteorologists can choose between the operational H-E, the original AE, and the IFFA for operations. The H-E is used most of the time, but there are still some situations when the AE and IFFA are better. The SAB Meteorologist uses what he considers to be the best estimates for the SPENES text message and also for the graphic product that goes onto the Internet. Using automatic rainfall estimates for the past 2 to 3 years continues to result in more SPENES messages and more frequent messages. A record high number of messages for the month were sent in both May and December of 2002.

Other significant operational improvements in the NPPU included: continued intergration of AWIPS into precipitation operations; NOAA-17 began operations which means that AMSU data is now available every 3 to 4 hours; and the use of areal Tropical Rainfall Potential (TRaP) for tropical systems approaching the U.S. continued with several improvements.

During the 2002 hurricane season, the SAB precipitation program (in cooperation with the SAB Tropical Team) continued issuing experimental areal TRaP's using SSMI, AMSU, and TRMM satellite rain rate data for tropical systems approaching the U.S. The addition of AMSU and

TRMM (NASA Tropical Rainfall Measuring Mission) TRaP's is an improvement for 2002. Again, the SAB Meteorologist chooses which product is the best and uses that for the SSD web page. The TraP's are sent to the Internet Web page making them widely available for potential users such as the Tropical Prediction Center and NWS Forecast Offices. SAB also has the capability of doing TRaP's experimentally using H-E rainfall estimates. All the TraP's available to the SAB Precipitation Meteorologists are also very helpful in briefing HPC Forecasters on the rainfall potential with tropical systems approaching the U.S. In addition, a lot of progress was made in 2002 in developing an automatic TraP system which automatically generates TraP's for all tropical systems worldwide using data from all 3 satellite systems. These TraP's are now routinely available on the SSD web page.

One major milestone reached by the end of 2002 was the beginning of the transmission of an H-E graphic product onto the AWIPS. This is the first time a satellite rainfall estimate graphic has been available on an operational NWS system. The latest upgrade of AWIPS, software version 5.2.2, allows the AWIPS users to display a graphic of 1 hour H-E estimates every hour. The upgrade to this version began in October 2002 and will be completed by February 2003. By the end of 2002, a majority of AWIPS sites had already been upgraded. As a result, some minor changes were made in the SPENES message to reflect the fact that a graphic is now readily available to the Forecast Offices.

Also in October 2002, SAB began automatically doing an electronic search for references to SPENES messages by the Forecast Offices. Once references are found, then electronic copies are saved. This enables the SAB Precipitation Program to have examples of how products are being used, and also provides a measure of how useful our precipitation products are for NWS Forecast Offices.

Also during 2002, the Precipitation Team continued to assist ORA in the development and evaluation of experimental satellite rainfall estimating techniques. The Team assisted Bob Kuligowski of ORA in his ongoing evaluation study of all the ORA satellite estimating algorithms. The SAB Precipitation Team also had several meetings with the Hydrology Team of ORA to discuss operational needs in relation to the H-E, and its future development and improvements.

And finally, since the Hydro-Estimator product is now available to the NWS on AWIPS, there is a need for some training to be available to the NWS Forecast Offices on what it is and how to use it. As a result, work was begun in the middle of 2002 on an online training session which will be operated by the Virtual Institute for Satellite Integration Training (VISIT). VISIT is a joint NESDIS/NWS effort. The training will be conducted by SAB Precipitation Meteorologists with some assistance from ORA, and should begin in early 2003.

Rainfall Patterns for 2002

Attachments 3, 4, 5, and 6 show production statistics for 2002. The following discussion

highlights some of the major weather patterns of the year which are reflected in the production statistics. Winter storms frequented the Pacific Northwest southward to northern California in the winter months of early 2002. However, southern California and the Southwest remained dry through the spring. The dry conditions resulted in numerous wildfires and some record fire damage later in the year in the West during the spring and summer months. With the effects of the previous year's La Nina weather patterns gone, a siege of some very wet weather started from late winter into spring in the central U.S. from Texas northward to the upper Midwest and eastward to the central Appalachians. Particularly hard hit with flooding in the spring was the area from Kansas and Missouri eastward across Illinois to Indiana and parts of West Virginia. During the summer, heavy rains were most frequent over the northern Plains and upper Midwest, and Texas. Minnesota and Texas were particularly hard hit with flooding. A lack of even normal rainfall continued to worsen drought conditions in the East during the summer months.

The hurricane season from late summer through the fall brought some much needed heavy rains to the South along with some flash flooding. The season began slowly but peaked rapidly with a record number of named storms for September in the Atlantic basin. Heavy rain was the major concern with the storms that hit the U.S. since most of them were tropical storms, and the hurricanes that made it inland were rapidly weakening. Tropical Storm Bertha brought heavy rain to southern Louisiana in early August, and Tropical Storm Fay and its remnants caused flash flooding in south Texas in the beginning of September. Weak Tropical Storm Hanna brought heavy rains to the Florida Panhandle and southern Georgia in the middle of September, and rapidly weakening Hurricanes Isidore and Lili produced flash flooding in southern Louisiana and Mississippi in late September and early October.

During 2002 a moderate-to-strong El Nino developed in the Pacific. This resulted in changing precipitation patterns in the West, South, and East at the end of the year. Numerous winter storms pounded the West Coast beginning in the fall, and frequent rains fell over the south central states and spread to the Southeast and up the East Coast. The frequent rain storms and 2 late winter snowstorms almost wiped out the longstanding drought in the East. Dry conditions predominated in the north central states as is typical in an El Nino year.

Once again this year, the SAB Precipitation Program provided some support for heavy rains in Hawaii. Normally we do not support Hawaii because the rains there are very isolated and orographic, and satellite estimates cannot be done because of the very small-scale nature of the events and very warm infrared cloud tops. But occasionally a "kona low" taps into deep tropical moisture and produces heavy showers with colder tops. This happened during the winter months of early 2002 with the heaviest flash flooding on the big island of Hawaii at the end of January. SPENES messages were sent containing satellite guidance and some rainfall estimates, and some phone call coordination was done for this event.

Production Statistics

The production of SPENES messages continued high in 2002, following a trend of high output which started in 2000 when the Auto-Estimator became operational (see Attachment 5). In this

period, staff-hours remained constant and even down from previous years indicating a higher frequency of messages. This increased productivity for the last 3 years also means more messages per heavy precipitation event and more events covered compared to the years before 2000.

Looking closely at the individual graphs, Attachment 3 shows the normal maximum of SPENES's during the summer months and a minimum in the winter. Dry conditions prevailed in the West and East which can be seen in the low output of messages during the early 2000 winter months. The number suddenly increased in May with the onset of heavy rains and flooding centered in Missouri and Illinois. The number of messages leveled off somewhat in June when heavy rains ended in Missouri and Illinois, and the rains shifted northward with flooding rains in the upper Midwest and northern Plains centered in Minnesota. SPENES's peaked in midsummer in July when some devastating heavy rains and flooding hit Texas, and spotty heavy rains also returned to Minnesota and Missouri. SPENES messages, although still high, began their normal decrease in August when heavy rains were scattered around the central and southern U.S. while dry conditions continued in the East. July and August SPENES totals also include a brief and limited summer monsoon season in the Southwest mostly in Arizona and New Mexico. Despite brief locally heavy rains with all the tropical systems in September and October, messages fell off to normal levels in the fall as very dry conditions predominated in the north central U.S. El Nino storms on the West Coast added some to the totals in November, and can clearly be seen contributing to a record high number in December. December's totals were also added to by increased stormy weather in the East and the south central states.

The number of hours monitoring and estimating (staff-hours) on the graph in attachment 4 shows a pattern throughout the year similar to the SPENES graph.

The graph in attachment 5 shows the trends in yearly totals for the past 10 years for SPENES messages and for staff man-hours. The increased productivity for 2000 through 2002 because of the AE and H-E has already been noted. Also notice the steady increase in SPENES production since 1996. One reason was increasingly wet weather through 1998 due to the El Nino. Although drier weather returned to much of the U.S. in 1999 (notice that staff-hours dropped off after 1998), production of messages only dropped off slightly and then increased. Another reason for the general increase in SPENES's is the effort in SAB since 1996 to provide more frequent SPENES messages, not only for rainfall estimates but also as flash flood and heavy rainfall guidance even when there are no estimates. The more frequent messages (mostly for winter storms) are sent as a result of an NWS request for more guidance, particularly for winter storms into the U.S. West Coast. These messages make heavy use of SSMI and AMSU microwave data (rain rates and precipitable water) and analysis of GOES imagery and GOES Derived Product Imagery and Sounder products. In addition, there has also been an increasing number of SPENES's sent for lake effect snows in recent years. Also, while the number of SPENES messages was increasing over the past 5 years, the number of staff man-hours monitoring and estimating has fallen off showing increased productivity as mentioned earlier. And finally, although it is probably statistically insignificant, there has been a small decrease in SPENES messages the past 2 years due to the widespread drought conditions in many sections.

The tables of the top ten states receiving SPENES messages and the distribution by NWS regions

(see attachment 6) shows that Texas and the Southern Region were the leaders as usual in 2002. The main differences from the previous year were in the central and western U.S. The number to the Central Region increased significantly probably due to all the wet weather from Missouri northward to Minnesota in the spring and summer. And the SPENES's to the Western Region decreased because of the widespread drought. The Eastern Region remained about the same with abundant rains at the end of the year balanced out by drought through the summer. On a state-by-state basis, Texas increased with several major heavy rain events there. Missouri, Minnesota, and Illinois moved up in the top ten due to the spring and summer storms. In the West, Oregon moved up to receive the most messages and California dropped despite increased winter storms with El Nino at the end of the year. As a result of the overall dry conditions and a weak summer monsoon, Arizona fell out of the top ten and way down to number 22 in the overall rankings by state.

And finally, in an effort to better quantify our precipitation operations, for the past 3 years we have been keeping track of the number of heavy precipitation weather systems for which SPENES's have been sent (no chart attached). For our statistics we track and log distinct weather systems as seen on the satellite imagery. Many systems do not develop into big storms and only 1 message is sent. Some systems are long-lived storms for which many messages are sent. Large long-lasting storms can also generate several heavy precipitation systems as areas of heavy precipitation develop and dissipate on the satellite imagery. The total number of heavy precipitation systems for 2000 is 855, for 2001 is 847 systems, and is 919 for 2002. These numbers are up for 2002 and show a variation throughout the year similar to the staff hours which were also up slightly for the year. This averages to around 2.3 messages per system which is down slightly from 2001;again, possibly due to the drought

SAB's Precipitation Team consists of: Rich Borneman, Sheldon Kusselson, Chuck Kadin, Tom Baldwin, Jay Hanna, and John Simko.

Attachments

Distribution:

E/RA2 - A. Gruber/F. Holt
E/RA21 - R. Scofield/R. Kuligowski
E/SP - H. Wood/M. Matson
E/SP2 - R. Lawrence
E/SP23 - G. Serafino/J. Paquette
W/NP - L. Uccellini
W/NP31 - R. Kelly
W/OS31 - T. Graziano
W/OS11 - J. Heil

SATELLITE PRECIPITATION ESTIMATES..DATE/TIME 07/05/02 1335Z
SATELLITE ANALYSIS BRANCH/NESDIS---NPPU---TEL.301-763-8678
VALUES ARE MAX OR SGFNT EST. NO OROGRAPHIC CORRECTION UNLESS NOTED...
....EST'S FM:/GOES8-CNTRL AND E. U.S./GOES10-W. U.S...
LATEST DATA USED: GOES-8 1315Z HANNA

.
LOCATION...S TEXAS
.
EVENT...LARGE AREA OF HEAVY RAIN CONTINUES TO EXACERBATE FF IN S TEXAS.
.
SATELLITE ANALYSIS AND TRENDS...THE TREND FOR THE PAST FEW HOURS HAS BEEN A GRADUAL WARMING OF CLOUD TOPS OVER TRAVIS AND WILLIAMSON BUT RAIN RATES WITH THIS CONVECTION ARE STILL ESTIMATED AT UP TO 1.2"/HR. COLD CLOUD TOPS HAVE BEEN STATIONARY OVER THE PAST FEW HOURS TO THE WEST OVER THE COUNTIES OF BANDERA/KERR/GILLESPIE/KIMBLE AND VERY HEAVY RAIN IS ESTIMATED WITH THIS AREA OF RAIN AS RAIN RATES ARE ESTIMATED AT UP TO 2"/HR. OVER THE LAST FEW HOURS CLOUDS HAVE EXPLOSIVELY COOLED OVER THE COUNTIES OF ZAVALA/FRIO/DIMMIT/LA SALLE AND RAIN RATES WITH THIS AREA ARE ALSO ESTIMATED AT UP TO 2"/HR. SOUNDER PW LOOP SHOWS ANOTHER SURGE OF MOISTURE APPROACHING S TEXAS AND THIS WILL ONLY HELP TO CONTINUE THE EXTREMELY HEAVY RAIN OVER THE NEXT FEW HOURS. 6-HR ESTIMATES SHOW A 5.6" MAX OVER E DUVAL AND W JIM WELLS. A SECOND MAX IS ESTIMATED IN COMAL/HAYS WHERE UP TO 4.4" IS ESTIMATED. WILL CONTINUE TO MONITOR.
.
AUTOESTIMATES

TX COUNTIES	TOTALS	TIME
DUVAL/JIM WELLS	5.6"	700-1300Z
COMAL/HAYS	4.4"	"
KERR/BANDERA	4.0"	"
KARNES/LIVE OAK	3.4"	"
DIMMIT/LA SALLE	2.9"	"
TRAVIS	2.7"	"

.
...SEE GRAPHIC OF 6-HOUR ESTIMATES AT INTERNET ADDRESS LISTED BELOW...
.
SEE NCEP HPC QPF DISCUSSIONS AND QPF/S FOR FORECAST
.
HTTP://WWW.SSD.NOAA.GOV/PS/PCPN/
...ALL LOWER CASE EXCEPT PS/PCPN...
[ONLINE SSD PRECIP PRODUCT INDEX]
.
LAT...LON 3300 10000 3300 9600 2800 9600 2800 10000

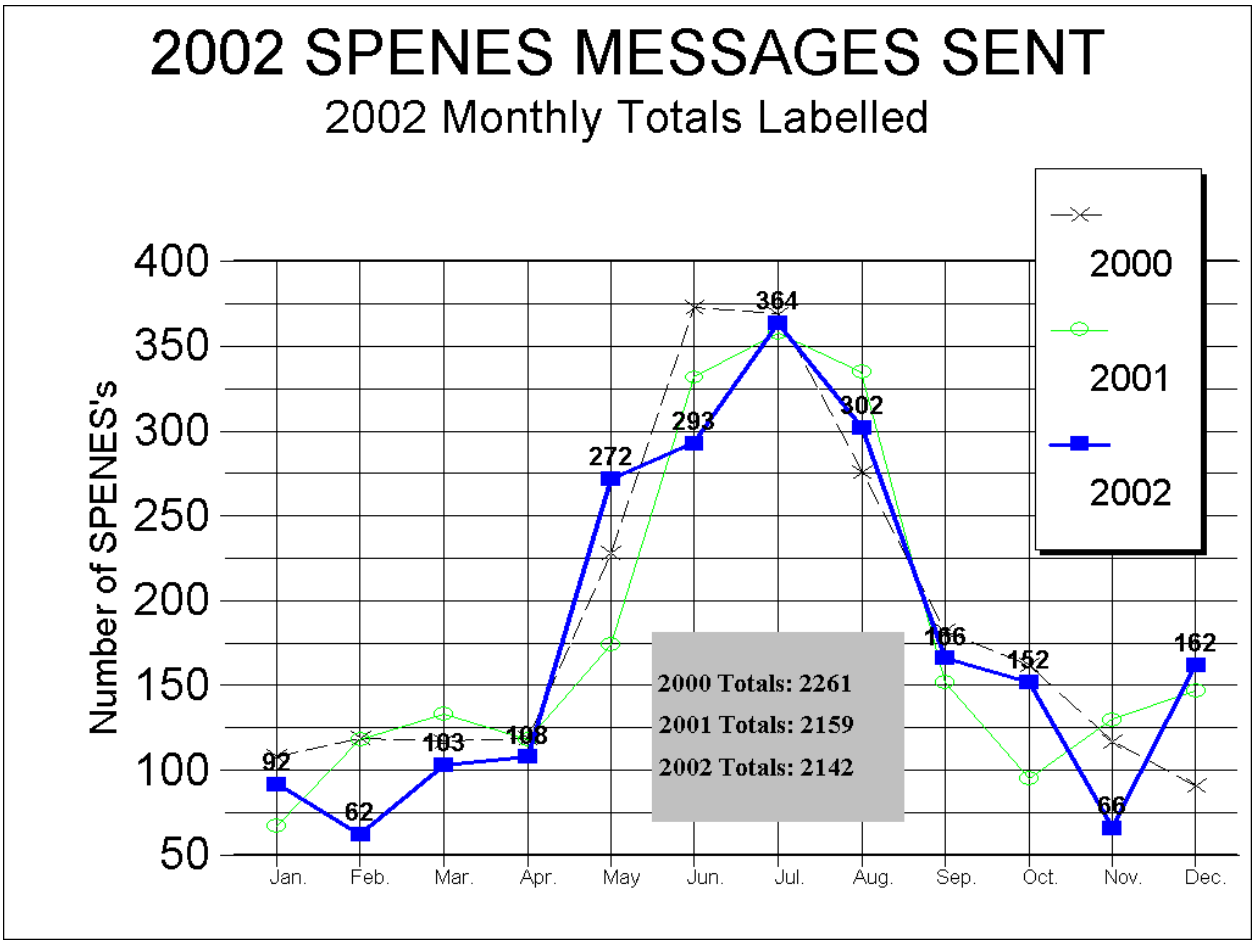
EXAMPLE OF SPENES MESSAGE SENT FOR FLOODING RAINS IN TEXAS

Attachment 1: Sample of SPENES Message.

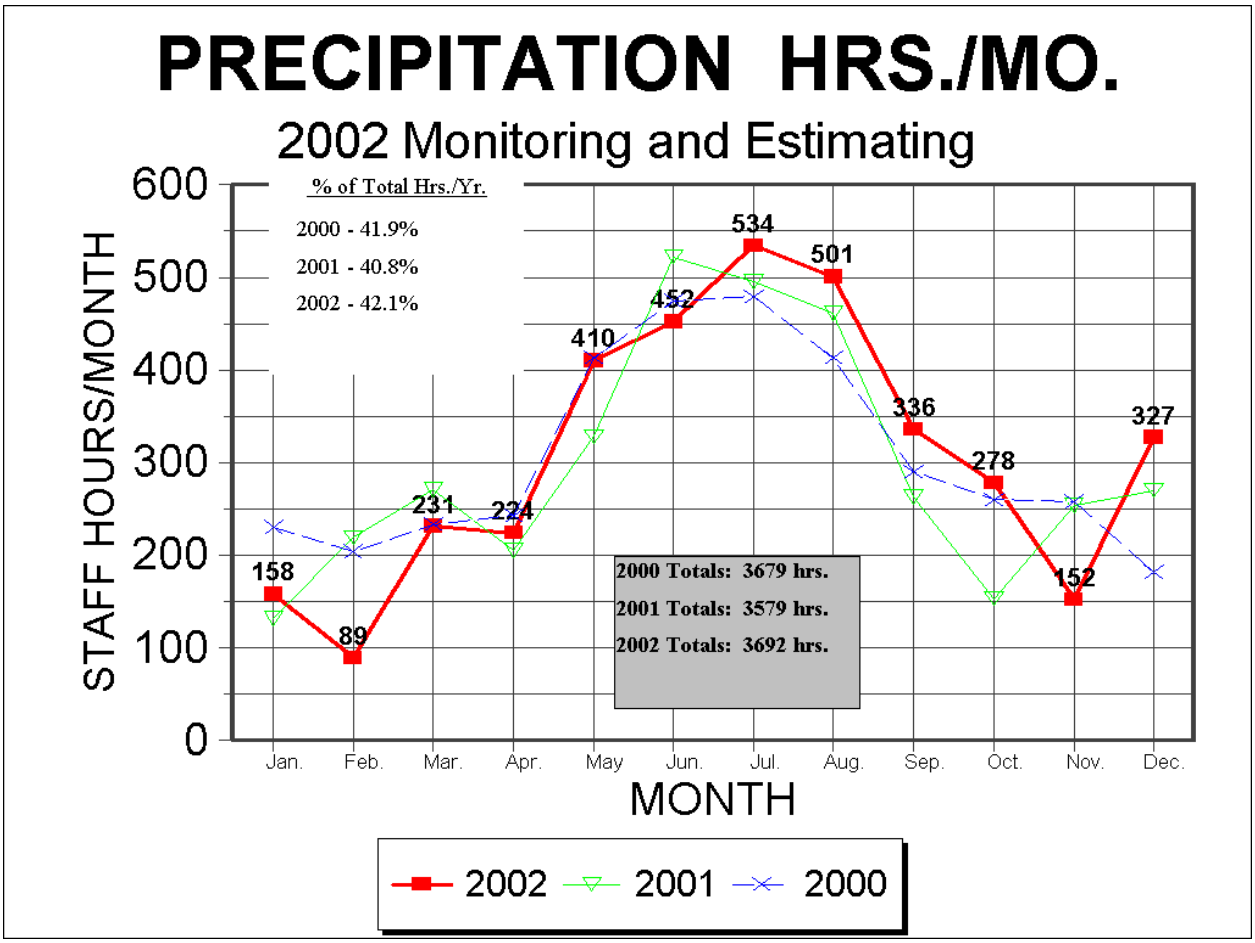
SATELLITE PRECIPITATION ESTIMATES..DATE/TIME 12/15/02 1955Z
SATELLITE ANALYSIS BRANCH/NESDIS---NPPU---TEL.301-763-8678
VALUES ARE MAX OR SGFNT EST. NO OROGRAPHIC CORRECTION UNLESS NOTED...
EST'S FM:/GOES8-CNTRL AND E. U.S./GOES10-W. U.S...
LATEST DATA USED: GOES-10 1930Z RB
DMSP SSMI: 1457-1644Z NOAA AMSU 1146-1534Z
.
LOCATION...W OREGON/N CALIFORNIA/W WASHINGTON
.
EVENT...HEAVY RAINS WITH FRONT APPROACHING COAST OR/WA AND ALREADY MOVING INTO N CA COAST.
.
MICROWAVE ANALYSIS...MOISTURE PLUME FILLING IN FM N OF HAWAII AT 29-34N AND EXTENDING EASTWARD TO COAST OF N CA/OR. PW/S NOT SPECTACULAR MOSTLY IN 1.0-1.3" RANGE BUT INCREASING AND ALL THAT IS NEEDED FOR HEAVY RAINS WITH STRONG UPPER JET AND STRONG DYNAMICS. DEEPER TROPICAL MOISTURE IS SEEN WORKING ITS WAY EASTWARD AND BEING ENTRAINED INTO THE MOISTURE PLUME N OF HAWAII WHERE PW/S ARE NR 1.5" AND SOME HIGHER FM THERE WESTWARD. MICROWAVE RAIN RATES AHEAD OF COLD FRONT MOVING TOWARD OR/WA MOSTLY .2-.4"/HR WITH SPOTS NR .5"/HR AND A BIT LOWER FARTHER S WITH COLD FRONT/WARM FRONT AIMING TOWARD N CA AT .1-.3"/HR.
.
SATELLITE ANALYSIS AND TRENDS...VIS IMAGERY SHOWS COLD FRONT 127-129W PUSHING TWD WA/OR/N CA. FRONT XTENDS WESTWARD ALONG 38/39N TO WAVE NR 38N/140W. XPECT HEAVY RAINS INTO COAST OR/WA NEXT 2-4HRS WITH SOME MODERATE/HEAVY SHOWERS ALREADY INTO N CA COAST IN WAA OVERRUNNING THE WARM FRONT. WV IMAGERY SHOWS UPPER VORT MAX/DEEPENING SURFACE LOW TURNING NORTHWARD NR 45N/130W AND UPPER SHORTWAVE TROF SOUTHWARD CROSSING STRONG UPPER JET NR 37N/140W. ADDITIONAL UPPER VORTS/CIRCULATIONS AIMED TOWARD N CA ARE SEEN MOVING RAPIDLY OUT NR 43N/157W AND 40N/150W. UPPER JET WITH SATELLITE WINDS 160-200KTS XTENDS WESTWARD TO DATELINE NR 32N AND BEYOND. AREA OF N CA WILL BE IN RIGHT FRONT QUAD OF JET WHICH WILL ENHANCE RAINS THERE LATER TODAY AND TONIGHT WITH FAVORABLE UPPER DIVERGENCE. NEEDLESS TO SAY..STRONG LOWER LEVEL WINDS WILL ENHANCE OROGRAPHIC EFFECTS ALL AREAS.
.
PCPN TRENDS...N-S ORIENTATION OF COLD FRONT INTO MOST OF W OR/W WA WILL MOVE HEAVY RAINS THRU FAIRLY RAPIDLY LATER THIS AFTERNOON AND TONIGHT WHICH WILL LIMIT AMOUNTS BUT CERTAINLY ENUF FOR ADDITIONAL RIVER FLOODING FOR RIVERS THAT ARE ALREADY HIGH. E-W ORIENTATION OF FRONT INTO SW OR/N CA AND WAVE ALONG FRONT WILL PROLONG PERIOD OF HEAVY RAINS THERE THIS AFTERNOON/TONIGHT/INTO TOMORROW BRINGING GREATER AMOUNTS AND ADDITIONAL FLOODING.
.
..NO ESTIMATE GRAPHIC ATTM...HYDRO-ESTIMATOR RAINFALL ESTIMATES ON ARE ON AWIPS IF YOU HAVE VERSION 5.2.2..

EXAMPLE OF SPENES MESSAGE FOR WEST COAST EL NINO STORMS

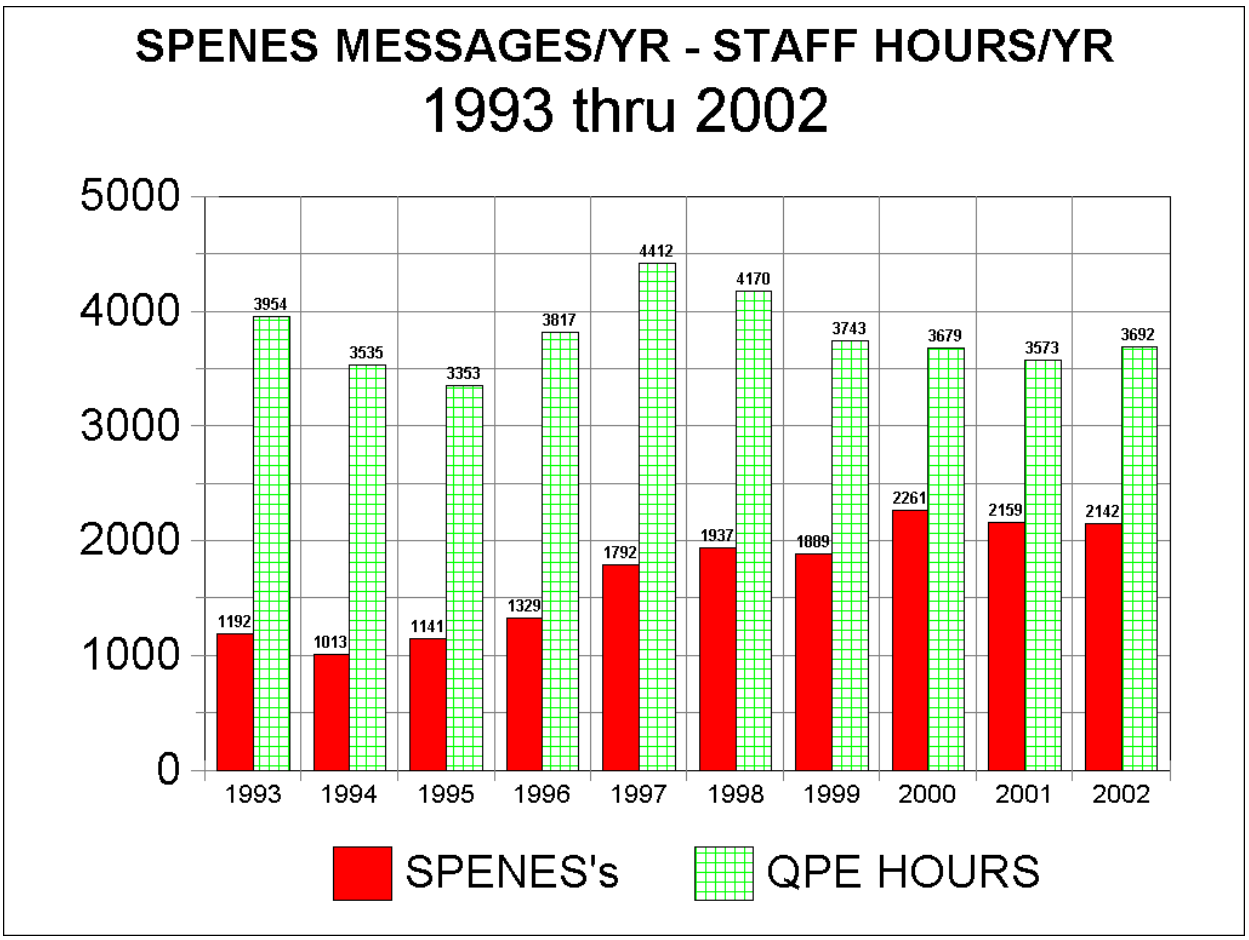
Attachment 2: Sample SPENES Message



Attachment 3: 2002 SPENES Production Statistics



Attachment 4: 2002 Staff Hours Monitoring and Estimating



Attachment 5: Staff Hours and SPENES Totals for Past 10 Years

TOP TEN STATES RECEIVING SPENES MESSAGES IN 2002

State	No. of SPENES's	Percent of Total
1. Texas	539	16.3%
2. Oregon	155	4.7
3. Missouri	154	4.6
4. California	136	4.1
5. Illinois	132	4.0
6. Minnesota	120	3.6
7. Oklahoma	112	3.4
8. Kansas	110	3.3
9. Washington	108	3.3
10. Arkansas	107	3.2

SPENES DISTRIBUTION BY NWS REGION

1. Southern Region	1274 SPENES's	38.4%
2. Central Region	1073	32.4
3. Western Region	501	15.1
4. Eastern Region	466	14.1

Attachment 6: SPENES Distribution by Region and State